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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Chain Drives
Their Lubrication and Maintenance

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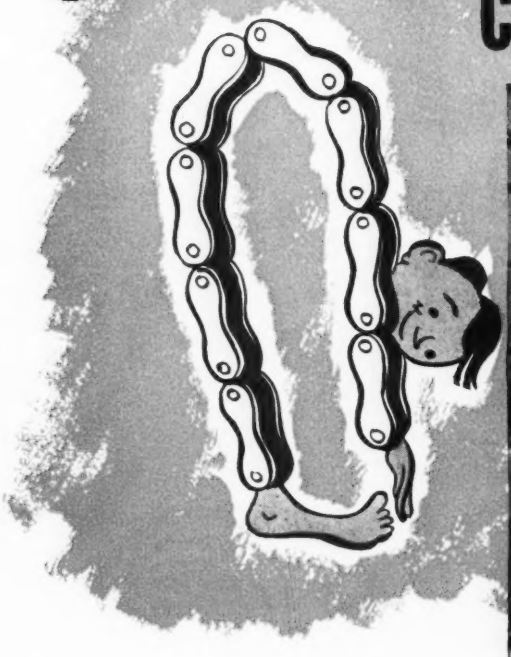
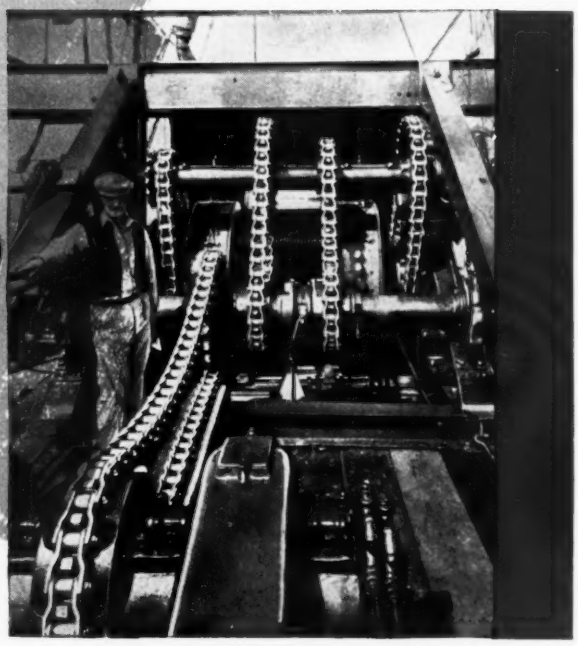
Links last longer

CHAINS KEEP LIMBER





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Chain Drives

Their Lubrication and Maintenance

THE history of power is fantastic in its recording of the ways and means devised to relieve man of manual labor. This seemed to be an ideal which developed from the overtime put in when the pyramids were built. Lubrication of sorts dates back likewise to those ancients, in their efforts to relieve their slaves of at least some of the work by greasing the rollers over which the stone blocks were pulled to these same pyramids.

The Egyptians were probably the first to adopt any substitute for man or animal power. They took advantage of the wind by means of the sailboat. In effect, this can be called the first machine; it became a most essential means of transportation on the River Nile. The vagaries of this same river caused an added need for irrigation. The low lands were flooded, irrigated and fertilized by the annual flood of the Nile, but the high lands, being above the flood level, required water by artificial means, for rain is scarce in this area.

So the forward Egyptians again proved their mechanical ability by developing a well-sweep device much like a crane. In this way water was dipped in a container, swung upward and over the area to be irrigated and there dumped.

As civilization progressed, application of the chain drive for power transmission was developed. About the time that Columbus was contemplating his famous voyages, an equally renowned artist-inventor, Leonardo da Vinci, designed sprocket chains for power transmission. Based on these fundamentals the chain has become a valued medium for power transmission where the distance between the driving and driven shafts is too great to allow for the use of gears.

TYPES OF CHAINS

The modern chain drive can be grouped under three distinct classifications according to the working conditions and degree of effective lubrication to which they are subject. These include:

(1) Malleable iron or stamped steel chains, used for rough service, running on cast tooth sprockets and usually operated dry, or lubricated by hand with an ordinary chain lubricant.

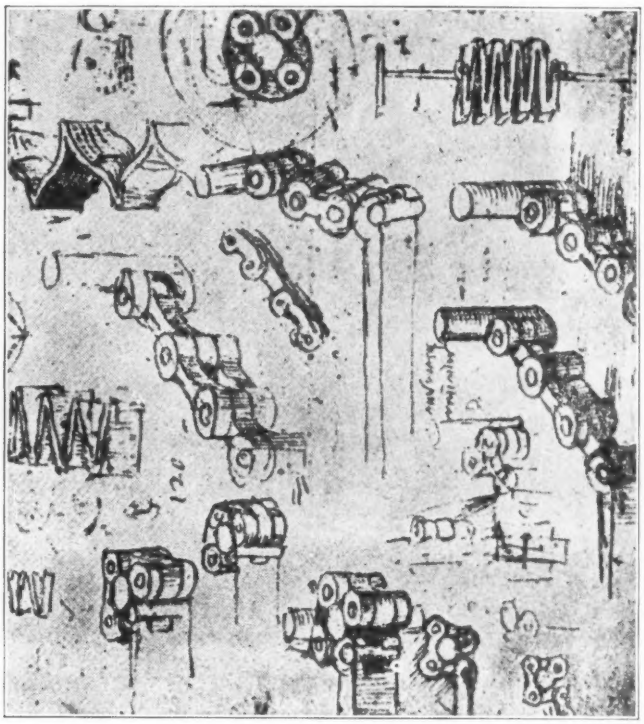
(2) Roller and block type chains which are built for durability, and designed for service with sprockets, the teeth of which are accurately cut to conform to the links, and

(3) Silent chains which are used in place of belts or gears in the transmission of power, where positive and quiet drive is necessary and where the distance between shafts is too great for practical use of gears and too short for belting efficiently. Link or silent chains are the most perfectly built chain mechanisms; they have proved their value by their power-saving ability, their quiet operation, and economical service where properly installed and lubricated.

Detachable and Pintle Chains, Etc.

The detachable chain is probably the cheapest and simplest type in use today. It is usually constructed of stamped steel or malle-

able iron links which are capable of engagement with each other. When the chain is straightened out it is impossible for the links to disengage; by folding or bending, however, the bar can readily be slipped out from the hook through the aperture in the latter. As a rule, detachable chains are used for elevator and conveyor service or for sprocket drives where a relatively low-cost durable chain is necessary. Due to the usual high clearances involved, chains of this nature are apt to wear rapidly in the presence of dirt, dust and other abrasive materials. Abrasive wear increases the pitch and frequently causes the chain links to fit unevenly over the sprockets. To counteract this the use of a highly adhesive, semi-fluid straight mineral chain lubricant has been found to be very beneficial where lubrication is possible.



Courtesy of Morse Chain Company
From "Power—Its Application From The 17th Dynasty to the 20th Century"
Fig. 1—Showing Leonardo da Vinci's conception of sprocket chains for power.

When detachable chains are to be used on sprockets a certain amount of slack may prevail. This can be corrected by using a coupler link built for pin connection. Links of this type can be readily inserted or removed as necessary.

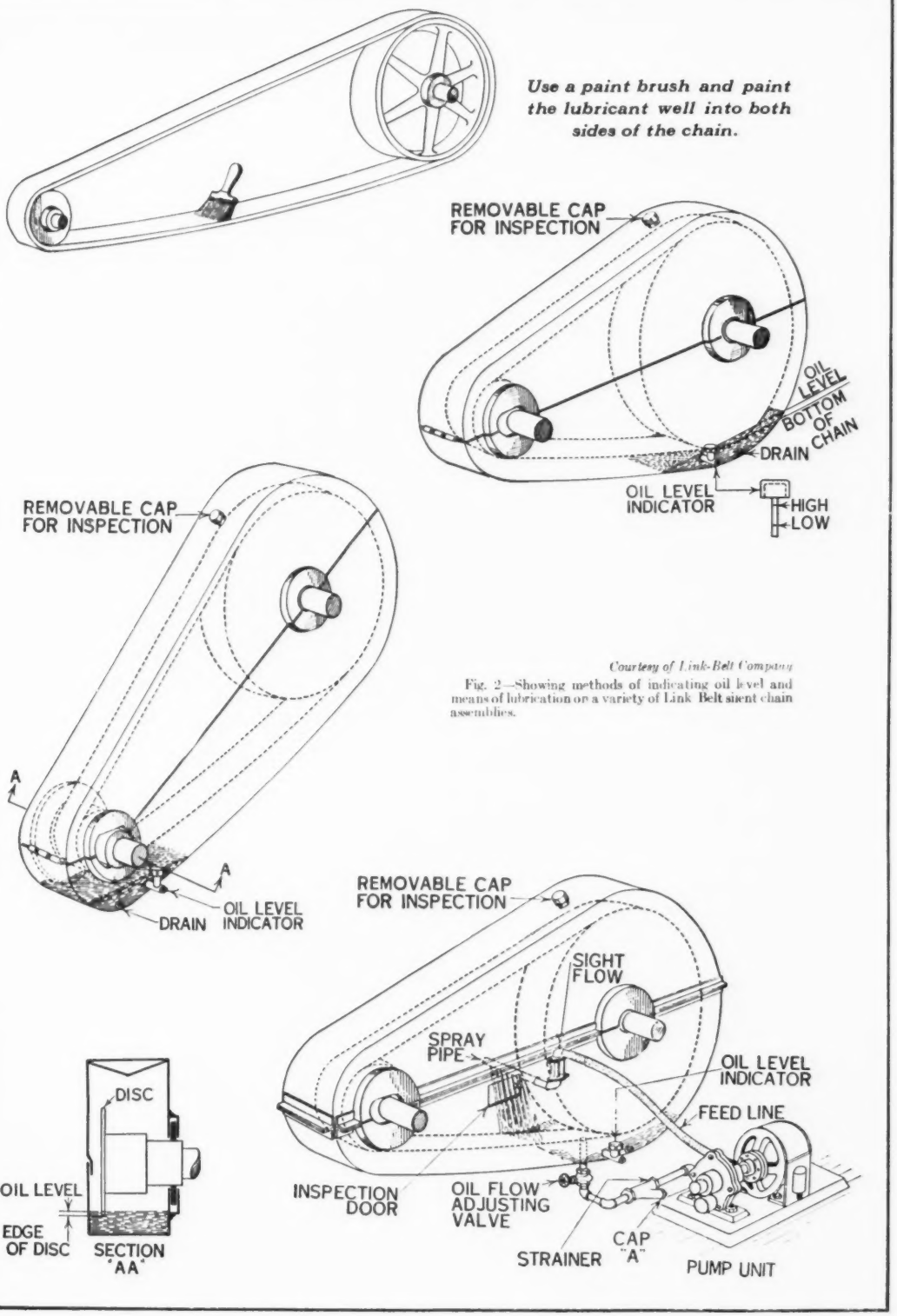
The pintle chain, extends the application of the malleable iron link to a pin connected device; it is a valuable substitute for the detachable chain when operating in the presence of abrasive materials. The connecting pins are either riveted over on the ends or held rigidly in the links by nuts or cotter pins.

Pintle chains are stronger than detachable chains by virtue of their construction and can therefore be used on somewhat heavier service. Variations of this type of chain include the saw mill pintle chain and the interlocking pintle chain. This latter is built with self-contained link connections which are effective in preventing the entry of dirt, dust or other abrasive matter. On the other hand there is sufficient end clearance to permit of ready entry of a comparatively heavy gear lubricant. Once such a lubricant has penetrated to the interior wearing surfaces, this clearance serves to retain it and prevent dripping or throwing during operation. Lubrication is impossible, however, where either pintle or detachable chains are used as drags in conveyor work, such as in the handling of sawdust, ashes or other fine materials.

Roller Chains

Roller chains are used where a relatively inexpensive, heavy duty, durable chain is required and where extreme quietness is not essential. They are most applicable to service wherein a silent chain would be a refinement, and yet where a cheaper rough chain of the pintle type could not be used. In other words, roller type chains extend the application of the efficiencies of a chain drive system to classes of work where otherwise the usual economies of modern industrial power transmission would not be attained.

Roller chain bearing surfaces are machined to a smooth finish in order to enable effective lubrication and insure against abnormal wear under comparatively high speed operation. Sprocket teeth are also constructed in the same manner. The extreme service under which certain tractor and automotive truck chains operate is an excellent example of what an average roller chain must be capable of enduring. As well, it is an ideal example of how the subject of lubrication enters into the question of chain operation. It is only necessary to note the condition of the driving chains on the average motor truck. In all probability they will appear to be coated with mud, or a caked mixture of dust and lubricant. This is but a surface indication, however. If a proper chain lubricant has been used, and carefully applied to the chains, in all probability the interior



Courtesy of Link-Belt Company

Fig. 2—Showing methods of indicating oil level and means of lubrication on a variety of Link Belt silent chain assemblies.

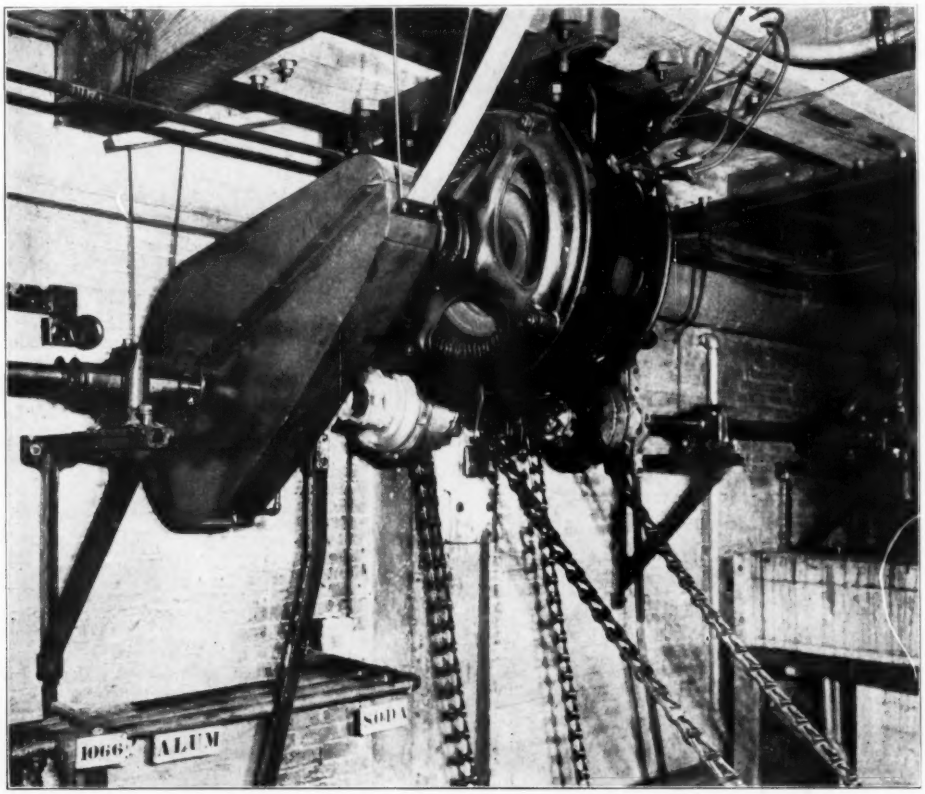
wearing surfaces of the links and rollers, etc., will be practically free from abrasive matter and coated with an adhesive, protecting film of the lubricant. In other words, this latter not only serves as a lubricant but also as a protective agent.

Oil Field Applications

Deep well drilling in the oil fields led to extended application of the steel roller chain. It became particularly applicable to the portable rig where either single or multiple strand chain assemblies are required. Chains of this type are specially machined after heat treatment in order to obtain holes which are accurate as to size as well as pitchwise. This provides for even load distribution, and more dependable lubrication. Drop forge construction of the side bars is another feature which facilitates self-lubrication, also giving greater reinforcement. All this, along with careful study of assembly procedure, has given the oil field chain very uniform bearing areas between each pin surface and its corresponding bushing. In this way the chance of bearing pressures being increased abnormally is markedly reduced; likewise, the possibility of galled joints.

Silent Chain Drives

Silent chains include all such driving mechanisms as are built up of parallel series of links fastened to each other and to the adjoining links by pins and bushings, or seat and rocker pins. This type of construction gives exceptional articulating or bending ability to the entire chain, with very little wear and noise.



Courtesy of Chain Belt Company

Fig. 3—An installation of a Chain Belt oil-tight lubricating case showing the oil fittings. Overhead drives must always be carefully planned so that dripped or thrown lubricants will be prevented.

provided lubrication is properly maintained. Unusual economy with regard to lubrication is obtainable on most chains of this nature, as little or none of the lubricant will normally be thrown off by centrifugal force, even under the higher speeds which are often prevalent. Therefore, cleanliness of operation is an important factor, especially on overhead installations where the chains and sprockets are sometimes exposed.

Although silent chain drives were originally designed for power transmission where neither belts nor meshed gears were practicable, they have completely outgrown this usage, and to-

day are competing with belts and gears on all manner of service.

Rigidity in every installation is an important feature. Therefore, bearings must be securely anchored in order to prevent vibration of shafts or the possible shortening of the distance between centers. In making such an installation shafts and sprockets should be tested for levelness; measurements being taken between shafts on each side of the sprockets in order to bring them directly parallel; and the sprockets lined up accurately by laying a straight edge across their sides. Alignment can be checked at any time after the chains have been in operation by noting the wear on individual links.

There are two distinct types of silent chains, of which the link or joint connecting device is the distinguishing feature. In one a pin or pin and bushings is used; in the other a "rocker joint" serves the purpose by the use of a seat and rocker pin. In chains of both types the pins are securely held in place by washers, and by riveting over the ends of the seat pin or roller pin as the case may be, or else by cotter pins. The chain proper consists of a number of parallel plates.

Courtesy of Diamond Chain and Manufacturing Company

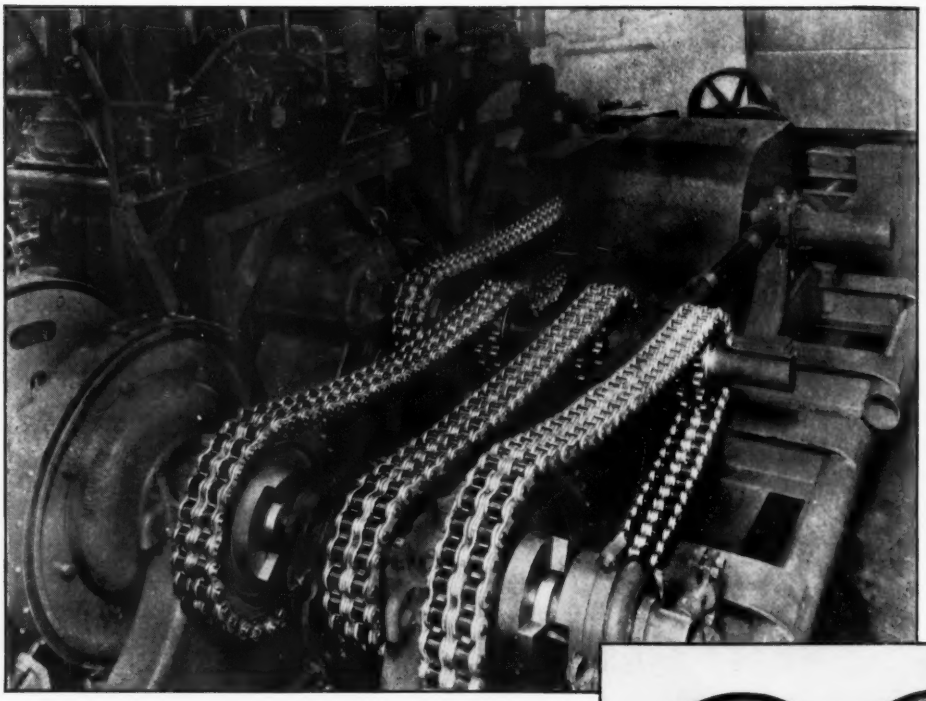
Fig. 4—A Diamond Chain drive casing—opened to show shaft—opening seal and roof drip plate which decreases oil flow on side walls, and to outside Vee gutter drains at shaft openings.

In chains of the roller joint type sliding friction occurs between the link pin and bushing. These bushings are generally constructed as segments, two being required per joint. By virtue of the uniformity of the bearing surfaces, wear occurs evenly between the pins and bushings. In operation, chains of this character fold into the sprocket teeth without jar, and each link fits perfectly with the corresponding tooth. In event of wear, radial adjustment is possible in order to compensate for any lengthening of pitch. Roller joint silent chains are retained in proper position on the sprockets and prevented from working off by the use of a center guide, or flanges on each side of the driving sprockets. Normally but little guiding is necessary, hence the wear on the sides of the guide is slight, especially as guiding takes place on the slack of the chain.

In rocker joint chains rolling friction occurs instead of sliding friction. This is attained by the elimination of bushings and use of two pins, one known as the "seat pin" which is built with a plane surface, the other, termed the "rocker pin" which has a convex surface. By inserting these pins into the links a rocking or rolling effect is attained when bending takes place. When wear occurs sufficiently on the bearing surfaces of these pins to cause lengthening of the pitch, it is only necessary to renew one or both pins to correct this objection. As a rule, wear between links and sprocket teeth is very slight, due to the uniform distri-

Courtesy of Diamond Chain and Manufacturing Company

Fig. 5—The Diamond Chain casing closed, showing sealing features, the lubricating fittings, and the inspection door.

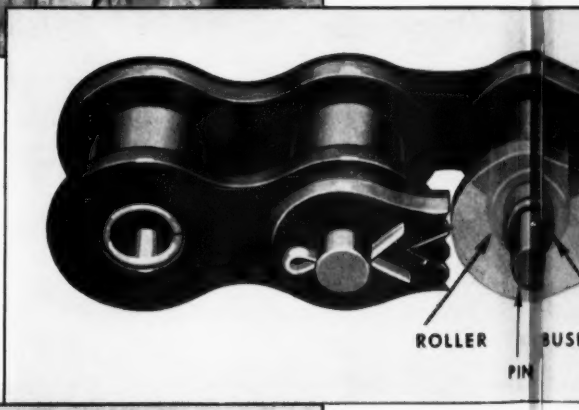


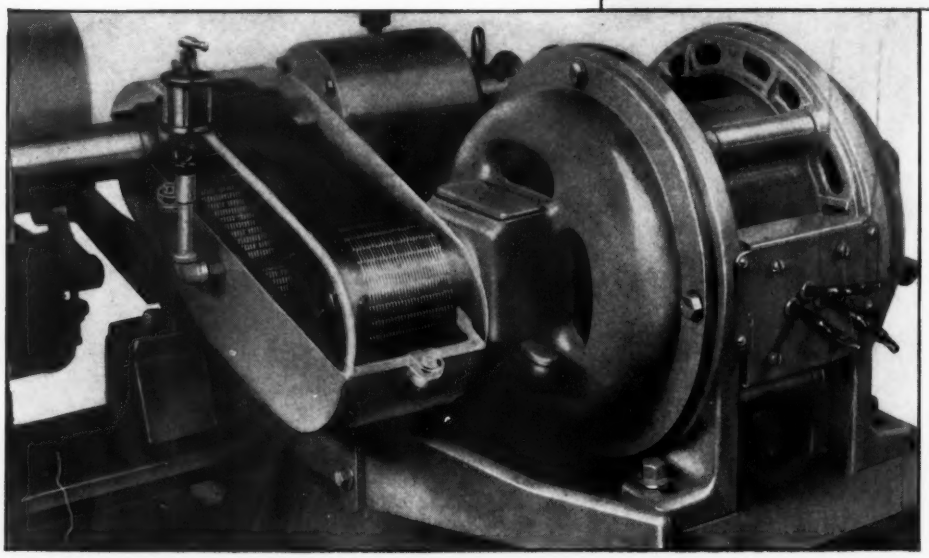
Courtesy of Link-Belt Company

Fig. 6—(Above)—View of Link-Belt double-width silverlink roller chain drives on a portable drilling rig in oil-field service. The precision finished all-steel construction of this type of chain makes it very durable on rotary drilling, cable tool rigs and other oil-producing equipment.

Courtesy of Diamond Ch and S

Fig. 7—(Below)—Cons tion Diamond roller chain. Ti type slip and its load is shared seve sprocket, like internal gear or a a pinion. Light bodied o of g recommended for such cha betw to 40 range according to erati the manner of housing a rovisi cation.

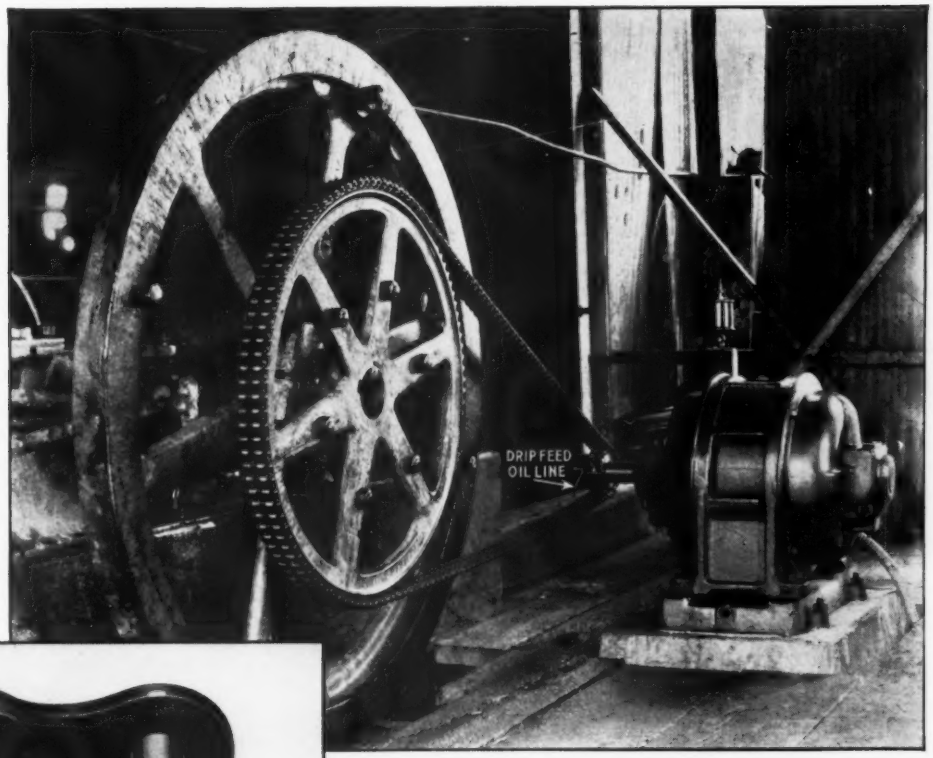




Courtesy of Ramsey Chain C

Fig. 9—(Left)—A Ramsey silent operating an automatic wo working chain speed is 2700 feet per minute. ternal sight-feed oiler and tight housing.

Fig. 10—(Right)— Link reducer with a spl roof steel chain drive from the revolving scrubber in the preparation plant.

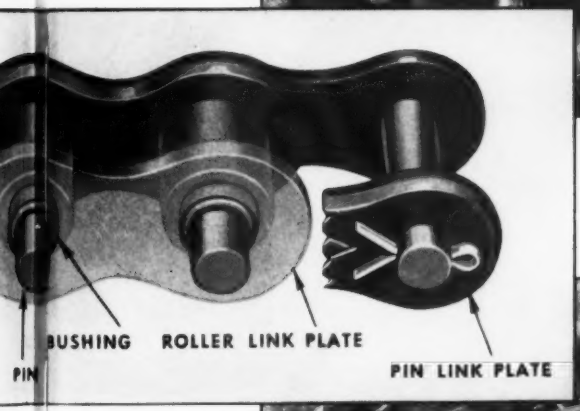


Courtesy of Chain Belt Company

Fig. 8—(Above)—A Rex roller chain belt drive operating an oil field pumping unit. Note that the chain is lubricated by the drip method from the oiler above the motor as indicated.

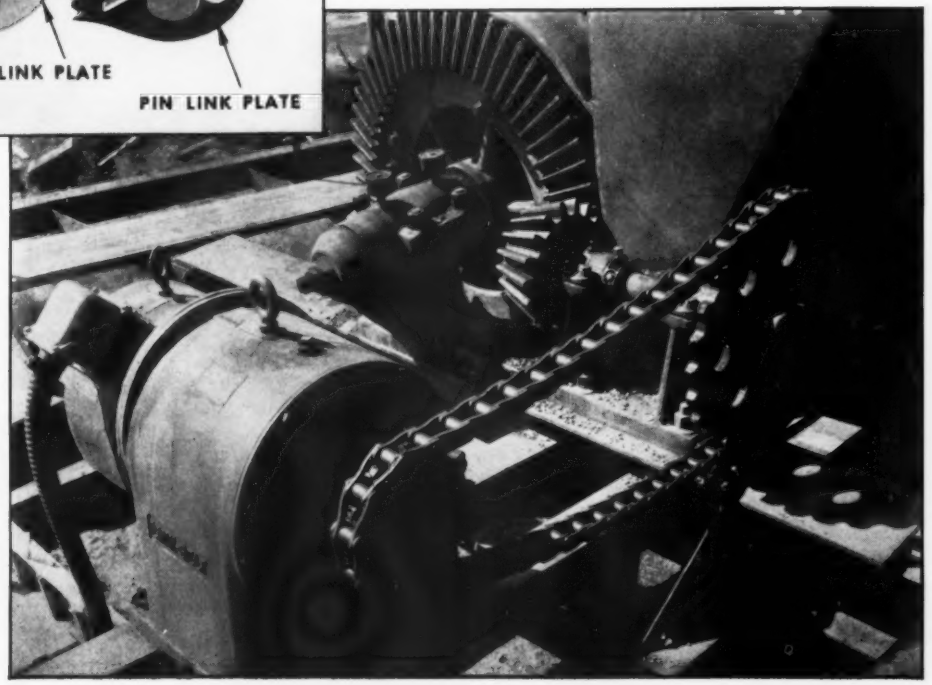
and Manufacturing Co.

—Construction features of the ain. The type of drive cannot shared several teeth in each al gear or a rack bent round odified s of good quality are such this between the SAE 20 ding to erating temperatures, sing arrovisions for oil appli-



Ramsey Chain Company, Inc.

Ramsey silent chain drive its woodworking lathe. The et per minute. Note the ex- r and tight-fitting chain



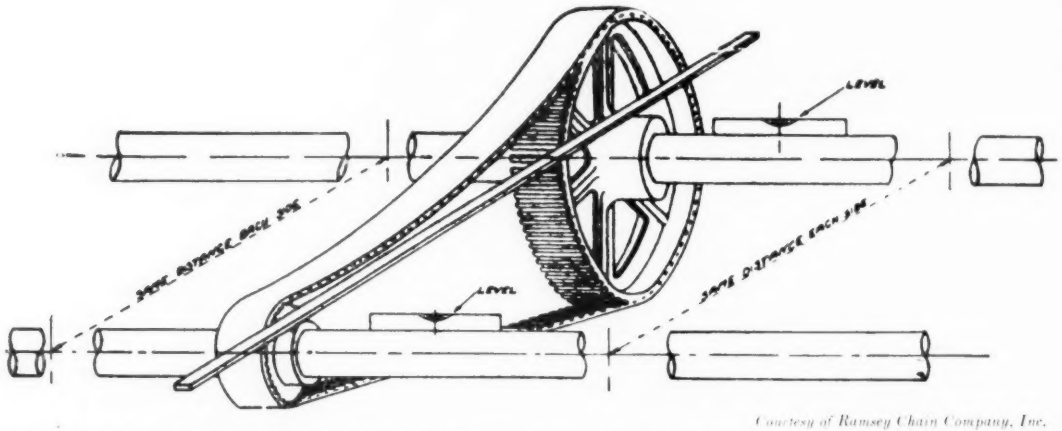
Courtesy of Link-Belt Company

Right)—A Link-Belt motorized speed a splashproof motor and an SS-40 rive from the reducer to a combination rubber-sten at a sand and gravel lant.

bution of driving pressure and equalization of pressure throughout the chain assembly.

FACTORS GOVERNING CHAIN LUBRICATION

To insure proper and efficient lubrication of driving chains, it is decidedly essential that the operating conditions be studied. In fact, only by combining a knowledge of such factors as speed, load, clearances and extent of bending or articulation can proper lubrication be assured. For example, a fluid product that would be adaptable to silent chains might often be altogether too light to suit the clearances prevalent in a detachable or pintle chain.



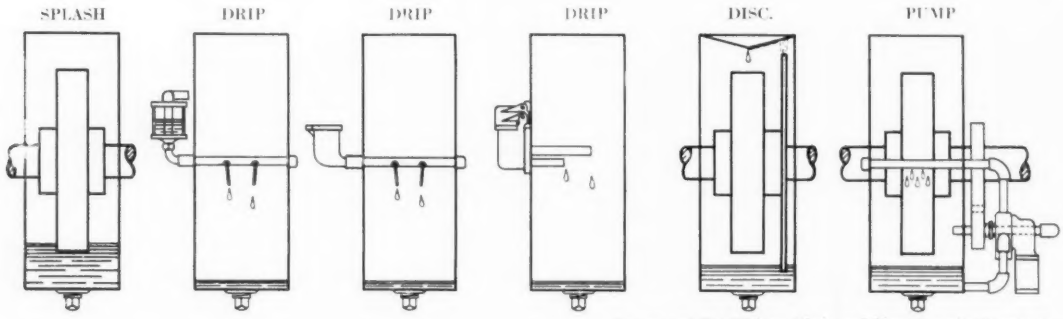
Courtesy of Ramsey Chain Company, Inc.

Fig. 11—Showing the Ramsey method of chain and shaft alignment for parallel and levelness by means of a straight edge and level. Perfect alignment is very important.

Speed and Load

Speed is important, since it involves the frequency of shocks due to engagement of the chain links with the gear or sprocket teeth. In other words, the greater the speed the more frequent will be the shock on each link. Whether or not shocks of this nature will be detrimental to lubrication will depend upon the load and constancy of operation. It is natural to expect that the rapid repetition of such shocks upon the bearing points of the chain will tend to force or squeeze the lubricating film out from between the rollers and bushings, or rocker bearing surfaces. It is not generally possible to compensate for this condition by increasing the viscosity of the lubricant to any great extent, as is often done on heavily loaded bearings, due to the fact that the penetrative ability of the lubricant would thereby be markedly decreased. Capillary action, however, will reduce the possibility of insufficient lubrication. It is customary to assume that the standard practice of load reduction with increase in speed will sufficiently reduce link shock to not only keep within the required factor of safety, but as well to insure continuation of effective lubrication.

Sudden starting and stopping usually impose an abnormally severe shock upon a chain, especially where heavy loads are picked up. To meet these conditions, to some extent the viscosity can be increased within the limits of

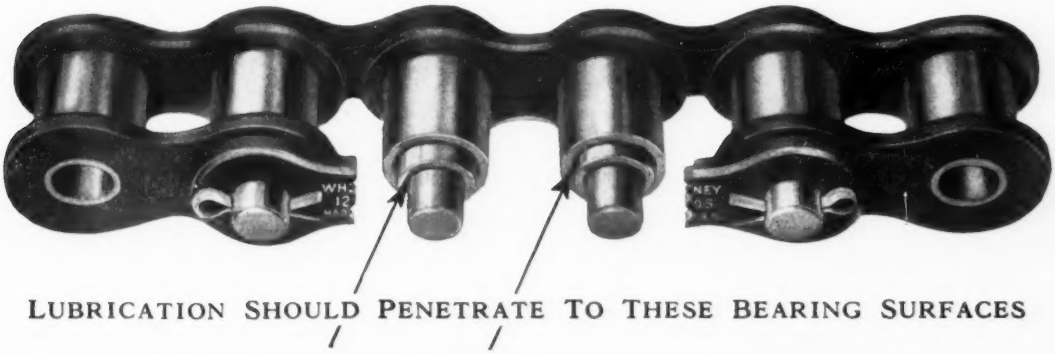


Courtesy of The Whitney Chain and Manufacturing Company

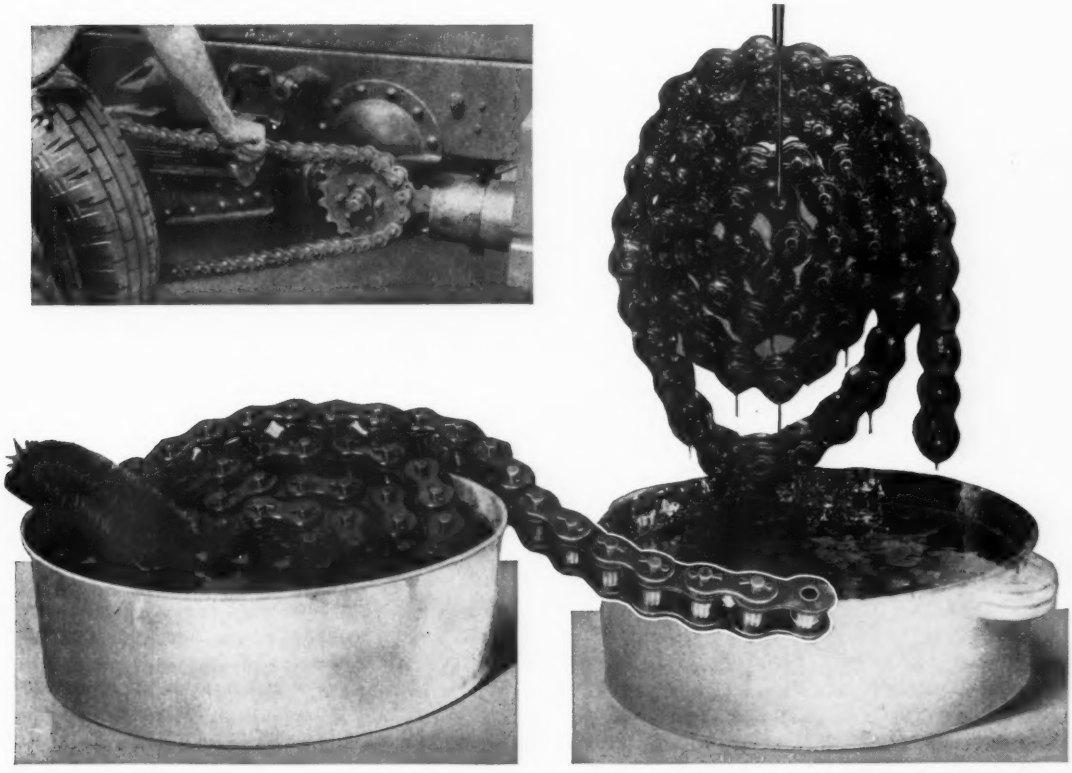
Fig. 12—The Whitney chain is provided for lubrication in a variety of ways as shown by the above methods.

penetrative ability of the lubricant, but perhaps the more satisfactory procedure will be to lubricate more frequently.

as possible this tendency towards friction and external wear, confining any necessary rubbing or rolling to the joints.



LUBRICATION SHOULD PENETRATE TO THESE BEARING SURFACES



Courtesy of The Whitney Chain and Manufacturing Company

Fig. 13—Details of the Whitney roller chain with methods of cleaning, re-lubrication and adjustment. After cleaning, lubrication is accomplished by immersing in a bath of hot heavy petroleum oil, the excess being allowed to drain off before installing the chain. After installation the adjustment should be checked.

Effect of Bending

Bending or articulation of a driving chain imposes wear not only on the link pin bearings, but as well at the points of contact between the chain and the gear or sprocket. In fact, this is the chief cause of external wear, both of the chain and sprocket, notwithstanding that correct chain design endeavors to eliminate as far

To this end, pins, bushings, roller, etc., are customarily built with adequate bearing surface to take up the usual strains. Still, a certain amount of external wear will be present in any case; for this reason an adaptable chain lubricant should be capable of effectively serving both internal and external wearing points.

Clearance and Lubricant Penetration

Depending upon the existing clearances, the lubricant must have a certain amount of fluidity in order to be able to penetrate thoroughly throughout the entire link whether pins and bushings, rollers or rocker joints are involved. On the other hand, to adequately prevent external wear of teeth and chain a relatively heavy adhesive lubricant may often be required which will adequately resist the effects of centrifugal force and stick to the wearing surfaces. Some lubricants of this nature may be so heavy or viscous as to render them incapable of complete penetration through the link clearances. This may require a compromise with sufficient viscosity reduction to meet one purpose, yet with the retention of as much adhesion as possible.

Courtesy of Ramsey Chain Company, Inc.

Fig. 14—Details of the Ramsey chain casing which provides a tight housing and maintains lubrication by oil drip onto the chain from an oil cup on the side of the case.

Certain steam cylinder stocks, or reduced petroleum residuums are excellent bases for such a lubricant. Where necessary they can be blended to the desired viscosity with lighter straight mineral products.

When chains must be operated in the presence of dust, dirt, chemical fumes or water, the load imposed upon the lubricant becomes all the greater. In such cases not only must it serve as a lubricant but as well as a protective agent for the pin and link bearing surfaces.

Grit, dust, acids and moisture will tend to promote wear and corrosion to a marked extent. Grit and dust in particular being of an extremely penetrative nature will tend to work into clearance spaces and immediately increase the wear. Unless the lubricant is of the proper viscosity and base, it will often become incorporated with such foreign matter and develop into an abrasive paste similar to a valve grinding compound.

SELECTION OF LUBRICANTS

The primary requirement of a chain lubricant is that it shall penetrate throughout the clearance spaces of the rollers, rockers or sliding surfaces of the links. It does no good to apply a lubricant to the surface of a chain if it has not the penetrative ability to reach all the wearing parts by virtue of its viscosity and the clearance between these respective parts.

For the Pintle Type

The more simple designs of chains such as the detachable and pintle types, may or may not be lubricated according to the nature of their service. Wherever possible, however, it will be advisable to attempt to lubricate them, unless they actually operate in contact with an excess of foreign matter; here a lubricant would become more of a detriment than a benefit. For detachable and pintle chains a relatively heavy lubricant of from 1,000 seconds to 2,000 seconds Saybolt viscosity at 210 degrees Fahr. will be suitable.

For Roller Chains

Roller chains practically always require lubrication. Oftentimes, however, this may be lightly regarded due to their seemingly rough construction, then waste oils are carelessly slopped on at intermittent intervals. Waste oils will lubricate, but due to the fact that they may often contain quite an appreciable amount

of sludge and abrasive matter their application is not recommended. Best practice is to use a lubricant within the viscosity range recommended by the chain builders.

The lubricant can be applied by brushing uniformly over the wearing surfaces while the chain is operating slowly. It will be found advisable to heat heavier chain lubricants in order to facilitate the spreading of a thin, even coating.

Oil field roller chains must be most carefully lubricated due to the part they play in the production schedule. As a result, their lubrication requirements have been studied and a wide variety of long-time tests run to determine the protective ability of a variety of prospective lubricants. Experience has indicated that straight mineral lubricants are most dependable. The viscosity range is necessarily wide due to the varied means which may be provided for application. Normally, however, the oil can be readily applied by drip feed, by hand or used successfully in an automatic self-lubricating system.

For Silent Chains

Silent chains may be operated exposed, or in a relatively oil-tight casing. The speed of operation is oftentimes regarded as a guide as to whether a casing should be used. However, in service where dust, grit or other foreign matter is present, a casing is always advisable whatever the speed. Naturally, a chain which operates in a dust-proof, oil-tight casing which is equipped with some form of automatic lubricator, will operate most efficiently and require the least attention.

MEANS OF LUBRICATION

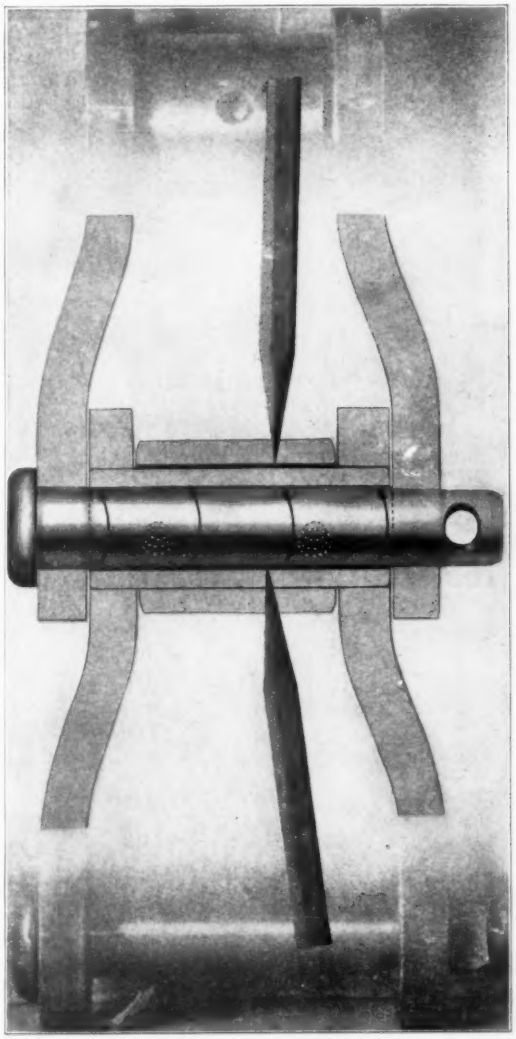
An effective type of casing chain-lubricator makes use of the principles of splash lubrication by means of a disc attached to one side of the main shaft. As the sprocket wheel rotates the disc dips into the oil in the base and throws it to the top of the casing which is built in the shape of a wedge. As a result there is a continuous and uniform dripping of oil upon the chain. In casings of this type the oil level is below the chain; the disc dips therein to a depth of one-eighth to one-half inch.

Other types of casings depend upon bath lubrication, in which event the oil level should be somewhat above the lowest part of the chain.

Casings which are used on high speed chains are often equipped with an oil pump. Forced lubrication is thus attained and the oil sprayed continually upon the chain.

When silent chains are operated exposed, the lubricant must be applied either by brushing it uniformly over the driving surface, or by removing the chain and immersing it in a bath of oil. Certain manufacturers of chains of this nature treat them with the lubricant before they leave the factory, in order to give them a good start in life. Usually a soaking bath is used, the chains being immersed for a sufficient length of time to allow penetration to all interior parts. Such a treatment will insure efficient lubrication over at least a month of normal operation. Subsequent soaking of the chain in the lubricant at periodic intervals is advisable.

When it is impossible to remove a silent chain for such treatment, the bearing or driving surface should be brushed or otherwise treated with a light, uniform coating of lubricant about once a week or more frequently if necessary.



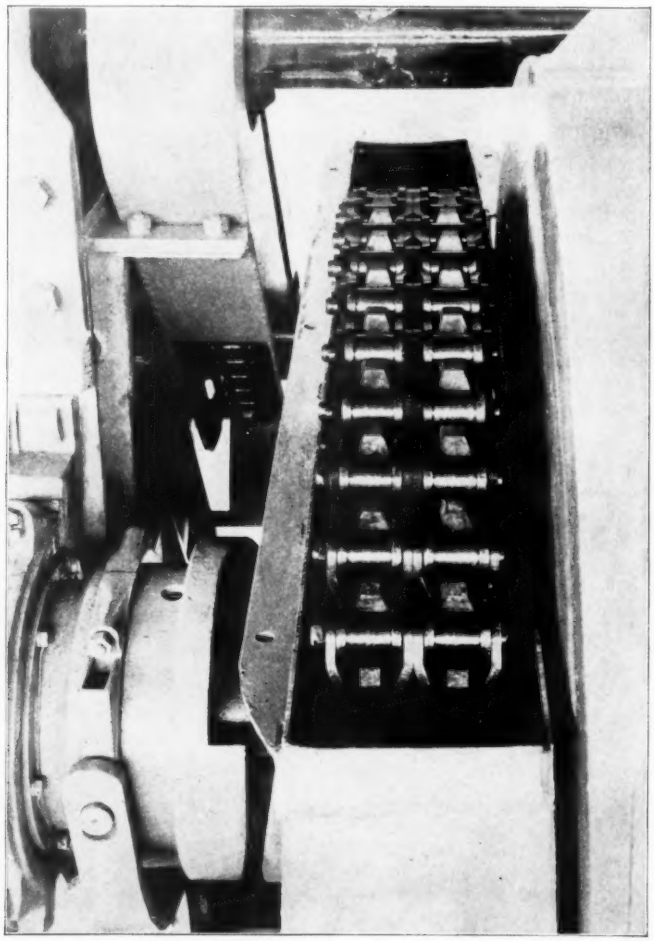
Courtesy of Chain Belt Company

Fig. 15—Sectional view of the Rex oil well chain showing where the abrasive action of steel on steel at high speeds is most pronounced and where lubrication is, therefore, most important.

If this is done during slow operation considerable penetration will occur to all the joints through the combined effects of bending and capillary action.

Due to the fact that clearances in silent chains are usually very small, it is generally advisable to use a relatively fluid straight mineral lubricant. When chains are encased, if they are to be bath lubricated, a medium bodied engine oil having a viscosity of about 500 seconds Saybolt at 100 degrees Fahr. will be suitable. Where exposed, or encased but not submerged in oil, a heavier lubricant such as a straight mineral cylinder oil or light gear oil should be used. Considerable difference of opinion often arises as to the use of greases or other semi-solid products. In many cases these would serve the purpose admirably, especially on such chains as have sufficient clearance to enable proper penetration. Still it can be appreciated the lubricant must have a certain ability to flow, and we cannot always depend entirely upon capillary action to bring about suitable penetration to the pins, bushing or rockers, etc.

In conclusion, it is well to remember that chains and casings will often require cleaning, especially if operating conditions are not of the the best, or entry of dust or dirt occurs. In such cases a kerosene or gasoline wash will be found satisfactory. Chains should be removed if possible and immersed in this wash. Cases should be drained and rinsed out to insure the removal of all sediment that may have collected.



Courtesy of Chain Belt Company

Fig. 16—Exposed view of the Chain Belt oil tight case showing protected surfaces of the chain links.

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TEXACO LUBRICANTS FOR CHAIN DRIVES

ROLLER AND BLOCK TYPE CHAINS

OPERATING TEMPERATURE RANGE	OPERATING CONDITIONS	
	Where chains are worn or subject to dirt, dust, water or chemicals	Where surroundings are clean, or chains are new or enclosed
High	Texaco Crater No. 1	Texaco Thuban 140
Medium	Texaco Thuban 140	Texaco Thuban 90
Low	Texaco Thuban 90	Texaco Altair Oil

SILENT CHAINS

OPERATING TEMPERATURE	CHAINS EXPOSED		CHAINS ENCASED	
	Worn Chains	New Chains	Bath Lubricated	Force Feed or Splash Lubrication
High	Texaco Thuban 140	Texaco Thuban 90	Texaco Pinnacle Min. Cyl. Oil	Texaco Texol F or Texaco Pelican Oil
Medium	Texaco Thuban 90	Texaco Star Grease No. 00 or Hytex Grease No. 3	Texaco Thuban 90	Texaco Altair Oil
Low	Texaco Star Grease No. 00 or Hytex Grease No. 3	Texaco Aleph Oil	Texaco Aleph Oil	Texaco Aleph Oil

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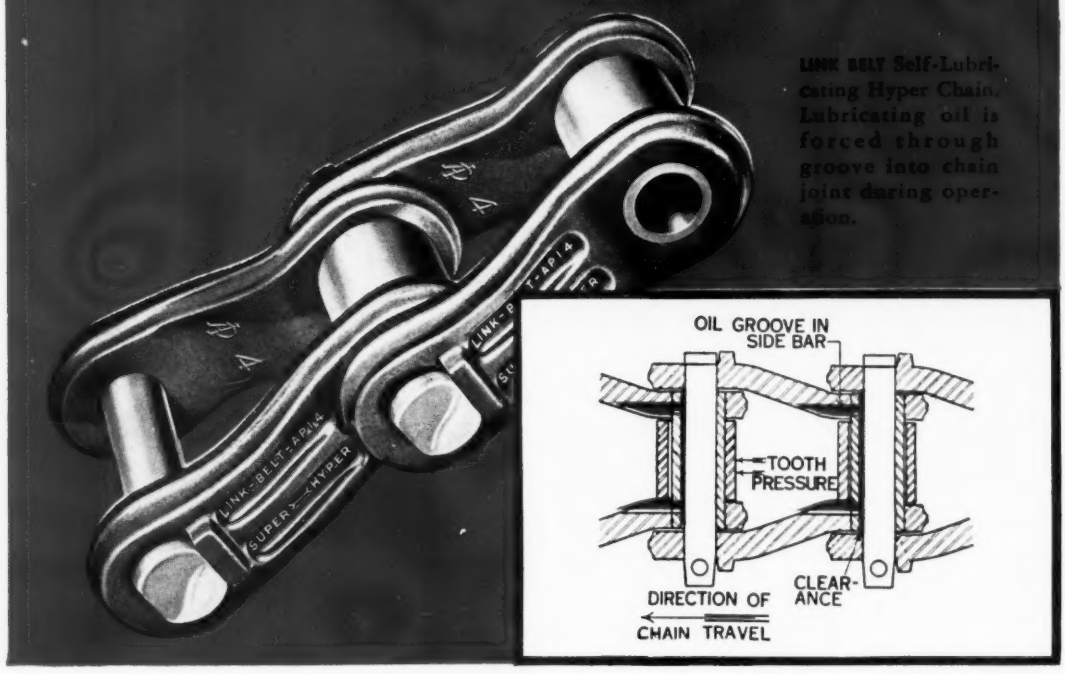
LONGER LIFE FOR CHAIN DRIVES


LINK-BELT Self-Lubricating Hyper Chain. Lubricating oil is forced through groove into chain joint during operation.
OIL GROOVE IN SIDE BAR
TOOTH PRESSURE
CLEARANCE
DIRECTION OF CHAIN TRAVEL

YOUR CHAIN DRIVES will give many extra hours of service, run quieter, save power . . . when you use Texaco chain drive lubricants.

These Texaco Lubricants penetrate between bushing and pin, preventing metal-to-metal contact. They do not squeeze out or throw off. Winter and summer they protect links, rollers and sprockets against wear and corrosion.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by chain drive users everywhere.

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